Optimizing Peri-operative Care in Bariatric Surgery Patients

Coblijn, U.K.

2018

document version
Publisher's PDF, also known as Version of record

CHAPTER 13

Evaluation of the Obesity Surgery Mortality Risk Score (OS-MRS) for the prediction of postoperative complications after primary and revisional laparoscopic Roux-en-Y gastric bypass

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Published in: Surg Obes Relat Dis. 2016 Sep - Oct;12(8):1504-1512

Abstract

Background: The Obesity Surgery Mortality Risk Score (OS-MRS) is a validated instrument for mortality risk prediction in patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB) procedures classifying patients into low risk (class A), intermediate risk (class B) and high risk (class C).

Objectives: the primary aim of this study was to evaluate the accuracy of the OS-MRS in predicting postoperative complications following LRYGB. Secondarily, the postoperative complication rate between primary and revisional LRYGB was systematically analysed.
Setting: The Obesity Centre Amsterdam, located in a large teaching hospital, in Amsterdam, The Netherlands.

Methods: The OS-MRS was applied to a consecutive database of LRYGB patients from November 2007 onwards. Postoperative complications were scored according to the Clavien-Dindo classification. Revisional LRYGB was separately analysed.

Results: LRYGB was performed in 1,667 patients either as primary (81.5%) or revisional (18.5%) procedure. The majority (n = 1371, 82.2%) were female, mean age 44.6 (SD 14.4) years and mean body mass index (BMI) 44.2 (6.5) kg/m^2. Nine hundred and four (54.2%) were OS-MRS class A, 642 class B (38.5%) and 121 (7.3%) class C. Complications occurred in 143 (10.5%) and 44 (14.2%) patients after primary and revisional surgery, respectively. In both primary and revisional LRYGB, there was no association between complications and the OS-MRS classification. Sub analysis comparing primary with revisional LRYGB showed a significant association of revisional surgery with the development, severe complications (Clavien - Dindo ≥ 3) *(p=0.003)* and mortality *(p=0.017)*.

Conclusion: The OS-MRS was not an accurate predictor for postoperative complications in patients who underwent primary or revisional LRYGB. As in other studies, revisional surgery is an independent risk factor for the development of severe complications.

Introduction

Obesity is a major health problem worldwide with 1.9 billion adults being overweight, of which more than 600 million were obese in 2014 [1]. The only long term effective treatment for morbid obesity with good long-term results is bariatric surgery which aims to reduce morbidity and mortality that is caused by morbid obesity and thereby increasing quality of life [2]. Although primary bariatric surgery is considered relatively safe with still significant but decreasing mortality rates (between 0.04% to 2.0%) in the last decades, postoperative morbidity is still substantial (ranging from 10% short term till 30% long term with an average of 11%) [3-6]. A reliable instrument that predicts postoperative risks could both improve patient education concerning the risks of surgery and provide preventive measures attempting to reduce the postoperative complication risk.

The Obesity Surgery Mortality Risk Score (OS-MRS) is developed a decade ago by de Maria et al. to predict postoperative mortality caused by primary gastric bypass [7,8]. This score predicts mortality based on five parameters: body mass index (BMI) ≥ 50; age ≥ 45; male gender; hypertension and risk on pulmonary embolism. The OS-MRS was the first scoring system validated in multiple, independent centres for mortality after laparoscopic Roux-en-Y gastric bypass (LRYGB) and should provide an accurate, risk adjusted prediction of the mortality due to this procedure [9,10]. Although the OS-MRS was not validated to predict post-operative complications, some authors do use this system for the comparison of patients with complications, as do some (inter)national databases [11,12]. To increase the insight in postoperative complications and their consequences, the Clavien-Dindo classification can be used to score the complications in severity [13].

In the previous decades, restrictive procedures such as the (laparoscopic) adjustable gastric band became very popular due to the relatively low operative complexity and the assumptive reversibility of the procedure. Although the short-term results were promising, this procedure has several limitations on the long term such as band slippage, -erosion, pouch dilatation or oesophageal dilatation that are reported in 15-58% of the patients [14-18]. In addition to this complication rate, the long-term weight loss was disappointing [19]. Due to the aforementioned limitations, an increasing number of patients opt for revisional surgery often into LRYGB or laparoscopic sleeve gastrectomy (LSG). Overall, around 6.3% of the bariatric surgical procedures exists of revisional surgery, of which the majority undergoes

revision into LRYGB [20]. Although revisional surgery in a single step procedure turns out to be feasible, revisional LRYGB has a higher complication rate than primary LRYGB [21,22].

The aim of the present study is twofold; first to evaluate the OS-MRS in its accuracy predicting postoperative complications and secondly to systematically compare primary LRYGB with its revisional counterpart in a large cohort to evaluate the risks of revisional surgery.

Methods

An electronic database, containing all consecutive patients undergoing bariatric surgery at the Obesity Centre Amsterdam, located in a large teaching hospital, the Sint Lucas Andreas Hospital, from November 2007 onwards, was retrospectively reviewed. All patients met the criteria as described by the International Federation for the Surgery of Obesity and Metabolic diseases [23]. Patients who underwent primary or revisional LRYGB from November 2007 until April 2015 with a minimal follow up of one month were included.

Preoperative screening:
All patients were preoperatively screened by a multidisciplinary team, focusing on physical, psychological and dietary functioning. Furthermore, all patients underwent a poly(somno) graphy to detect obstructive sleep apnoea, and esophagogastroduodenoscopy to inspect the future remnant stomach providing the possibility to treat (pre) malignancies prior to surgery or a faeces test to detect and if necessary eradicate *H. pylori* infection. Patients were preoperatively counselled to quit smoking.

Surgical procedure:
LRYGB was performed by three experienced bariatric surgeons or under their direct supervision. In case of a revisional operation, the procedure started with removal of the band followed by direct revision. Pneumoperitoneum was obtained. Five trocars (three 12mm and two 5mm) were used. The proximal jejunum was identified and the future position of the gastrojejunostomy (GJ) was moved up to assess if a tension free anastomosis was technically feasible. The pouch was created in the lesser curvature using one horizontal and two to three vertical firings of a 45 mm endoscopic stapler (Johnson and Johnson, Somerville, NY, USA), leading to a pouch size of approximately 30 ml. The Roux limb was

tension free positioned in an antecolic, antegastric fashion. The GJ was stapled with a linear endoscopic stapler. The anterior aspect of the GJ was closed using uninterrupted VICRYL 2.0 (Ethicon Inc. a Johnson and Johnson Company, Somerville, NY, USA) or a V-loc™ (Covidien, Dublin, Ireland). Subsequently 120-150 cm was measured after which the side to side jejuno-jejunostomy (JJ) was made with the linear stapler (the anterior side was closed with absorbable suture material, as previously described) and the connecting loop was transected. In case of a revisional procedure, the Port-a-cath was removed before the skin was closed.

Postoperative care

All patients were admitted in the hospital for at least 24 hours post-surgery and returned to the hospital or the 24 hours emergency room if any problems occurred. Both presentations were scored as a complication. Patients with severe sleep apnoea (an apnoea hypopnea index above 30), were monitored at the intensive care unit (ICU) the night after surgery. Non-steroidal anti-inflammatory drugs (NSAID's) were replaced by paracetamol or tramadol if necessary to avoid the ulcerogenic potential of NSAID's. From august 2011, all patients received a six months course of prophylactic pantoprazol® 40 mg and special vitamins and micronutrients were also prescribed. Preoperatively patients were required to sign a contract, submitting them to a follow regime of at least five years with an annual medical check-up and laboratory investigation.

Obesity Surgery Mortality Risk Score (OS-MRS)

The OS-MRS assigns one point to each of the following preoperative parameters: BMI ≥ 50; age ≥ 45, male gender, hypertension and a calculated risk for pulmonary embolism (defined as having obesity hypoventilation syndrome, venous stasis ulcers, a previous PE and/or inferior vena cava filter). The maximum score is five points [8]. Class A (low risk) are patients with 0 to 1 point, class B (intermediate risk) patients with 2 or 3 points and class C (high risk) are patients with 4 or 5 points.

All patients were assigned the appropriate points according to the relevant comorbidities and demographics and subsequently included into respectively class A (low risk), B (intermediate risk) or C (high risk) of mortality.

Definition of complications: Clavien- Dindo Classification

The peri-and early postoperative complications were graded according to a system for operative complications as proposed by Dindo et al. [24]. Since this classification categorizes postoperative morbidity and mortality based on the severity of the complication and the intervention needed to treat the complication, it consists of five grades and two subgrades: grade I complications do not need any medical or surgical intervention; grade II complications need pharmacological treatment but no active intervention; grade III complications need radiologic/endoscopic (IIIa) or surgical (IIIb) intervention; grade IV complications represent the life threatening ones and are classified as grade IVa, single organ failure, and grade IVb, multi organ failure and finally, grade V complications are those resulting in death. Next to grading according to the previous mentioned system all complications were also classified and coded according to their origin.

Patients who suffered from more than one complication were classified according to their most severe complication. All patients were seen at the outpatient clinic after discharge.

Statistical Analysis

All data were analysed using SPSS 21.0 for Windows (SPSS Inc. Chicago Illinois, USA). Age, gender, co-morbidities, intoxications and initial BMI were examined as predictors of complications, as were the OS-MRS classes and their separate risk factors. The Independent Student t- and Mann-Whitney U test were used to determine if any statistical significance for continuous variables and the Chi-square/ Fishers exact test for the dichotomous variables. Two-sided p-values of less than 0.05 were considered significant. Analyses were carried out for primary and revisional LRYGB separately.

Results

Bariatric surgery was performed on 1797 patients between November 2007 and April 2015. A total of 130 patients were excluded due to different procedures, 118 underwent primary LSG, 10 patients had revision into LSG, 2 patients had a revision from a LRYGB into a banded LRYGB.

Primary laparoscopic Roux-en-Y gastric bypass and the impact of the OS-MRS

Primary LRYGB was carried out in 1,359 patients of which 1,105 were female (81.3%), the mean age was 44.5 (SD 15.1) years and mean BMI 44.8 (6.3) kg/m^2. There were no significant differences in baselines between patients with and without a complication or between patients with and without a severe (Clavien- Dindo ≥ 3) complication *Table 1a*. Of all included patients, 29.6% of the patients suffered from diabetes mellitus type II, 23.3% had dyslipidaemia, 41.9% had hypertension and 64.1% suffered from OSA of which 19.8% had a severe form (classified as an apnoea hypopnea index > 30 per hour). Out of 1359 patients, 717 (52.8%) belonged to class A, 538 (39.6%) to class B and 104 (7.7%) to class C. Complications occurred in 143 patients of which 58 experienced a severe complication. Seventy-one patients belonged to class A (49.7%), 60 (42.0%) to class B and 12 (8.4%) to class C, this difference was not statistically significant with a p value of 0.734 *Table 1b*. The distribution of complications among OS-MRS A, B and C was 9.9, 11.1 and 11.5 percent respectively *Table 1b*. Additionally, analysis showed that the OS-MRS did not predispose for the severe complications either with a distribution of 4.2, 3.8 and 3.2 percent among OS-MRS A, B, C respectively (*p = 0.879*, *Table 1a and 1b*). None of the selected baseline characteristics, or the individual risk factors of the OS-MRS predisposed for any, or severe postoperative complication. Mortality occurred in two (0.1%) patients who underwent primary surgery, one patient belonged to OS-MRS class A, the other to class C.

There was no difference in distribution among the classes between the present and other studies as displayed in *Table 2* [7-9,25,26].

Table 1a: Analysis primary LRYGB

Baseline (n = 1358) & (n = 1263)	No complication < 30 days	Complication < 30 days (n= 143)	P value	No complication < 30 days	Clavien-Dindo ≥ 3 (n = 58)	P value
Gender F/M	993/222	111/32	0.234	991/222	41/9	0.957
Age (years; SD)	44.4 (15.5)	45.4 (11.4)	0.424	44.4 (15.5)	44.9 (10.6)	0.793
Weight (kg; SD)	127.9 (22.7)	125.8 (24.0)	0.312	127.9 (22.7)	130.1 (24.7)	0.498
BMI (kg/m^2; SD)	44.9 (6.3)	43.8 (6.4)	0.063	44.9 (6.3)	45.4 (7.2)	0.607
Waist (cm; SD) (n = 1196)	129.7 (14.6)	129.2 (15.6)	0.719	129.7 (14.6)	131.5 (14.9)	0.421
Comorbidities						
Diabetes (%)	357 (29.4)	44 (30.8)	0.731	357 (29.4)	17 (34.0)	0.488
Dyslipidemia (%)	277 (22.8)	40 (28.0)	0.168	277 (22.9)	13 (26.0)	0.604
Hypertension (%)	505 (41.6)	64 (44.8)	0.464	505 (41.6)	20 (40.0)	0.818
OSA Y/N (%) (n = 562)	593 (64.2)	75 (64.1)	0.987	592 (64.2)	26 (65.0)	0.919
AHI >30 (%)	240 (19.8)	28 (19.7)	0.981	239 (19.8)	7 (14.3)	0.344
Alcohol (%)	448 (37.7)	60 (42.9)	0.233	446 (37.6)	30 (40.8)	0.646
Smoking (%)			0.814			0.648
— *Now*	235 (19.6)	28 (19.9)		235 (19.6)	8 (16.3)	
— *Former*	279 (23.3)	36 (25.5)		278 (23.2)	14 (28.6)	

AHI: apnea- hypopnea- index; BMI: body mass index; F: female; LRYGB: laparoscopic Roux-en-Y gastric bypass; M: male; N: no; OSA: obstructive sleep apnea; SD: standard deviation; Y: yes

Table 1b: Distribution of complications among the OS-MRS primary LRYGB

Baseline (n = 1358) & (n = 1263)	Complications < 30 days (%)	No complication < 30 days	Complication < 30 days (n= 143)	P value	Severe complications < 30d (%)	No complication < 30 days	Clavien Dindo ≥ 3 (n = 50)	P value
OS- MRS class				0.734				0.879
OS- MRS A	71 (9.9)	645 (53.1)	71 (49.7)		28 (4.2)	644 (53.1)	28 (56.0)	
OS- MRS B	60 (11.1)	478 (39.3)	60 (42.0)		19 (3.8)	477 (39.3)	19 (38.0)	
OS- MRS C	12 (11.5)	92 (7.6)	12 (8.4)		3 (3.2)	92 (7.6)	3 (6.0)	
Age > 45 years (%)	80 (11.6)	603 (49.6)	80 (55.9)	0.153	26 (4.1)	602 (49.6)	26 (52.0)	0.742
BMI > 50 kg/m^2 (%)	24 (8.8)	248 (20.4)	24 (16.8)	0.305	14 (5.3)	248 (20.4)	14 (28.0)	0.197
Hypertension (%)	64 (11.2)	505 (41.6)	64 (44.8)	0.464	20 (3.8)	505 (41.6)	20 (40.0)	0.818
Risk on PE (%)	33 (11.0)	267 (22.0)	33 (23.1)	0.764	8 (2.9)	266 (21.9)	8 (16.0)	0.319

BMI: body mass index; F: female; LRYGB: laparoscopic Roux-en-Y gastric bypass; OS-MRS: Obesity Surgery Mortality Risk Score; PE: pulmonary embolism;

Table 2: Distribution of patients in different studies

Study	Total patients	OS-MRS A (%)	OS-MRS B (%)	OS-MRS C (%)
De Maria '06	2075	957 (46.1)	999 (48.1)	119 (5.7)
De Maria '07	4431	2164 (48.8)	2142 (48.3)	125 (2.8)
Efthimiou '09	2121	1385 (65.3)	671 (31.6)	65 (3.1)
Sarela '11	381	229 (60.1)	137 (35.9)	15 (4.0)
Lorente '14	198	124 (62.6)	70 (35.4)	4 (2.0)
Present study '15	1645	893 (54.3)	636 (38.7)	116 (7.1)

Comparison of primary and revisional surgery

The total group consisted of 1667 patients, from one patient with hypokalaemia in the primary surgery group, the Clavien-Dindo classification was unknown as the treatment was not noted in the patient's chart, therefore she was left out of the Clavien-Dindo analysis. Thirteen hundred fifty-nine patients underwent primary surgery and were compared to 308 patients with revisional surgery. The revisional surgery group had a significantly lower BMI (44.8 (6.3) versus 41.6 (6.4)) and contained more females (p value = 0.039). Although diabetes type II, dyslipidaemia, hypertension and (severe) OSA were significantly different, it was in favour of the revisional surgery group, *Table 3*. More patients undergoing revisional surgery belonged to OS-MRS class A, *p = 0.011*. Of the patients with severe complications, 17 required endoscopy or radiologic intervention, 45 a reoperation, three patients suffered from single organ failure, one from multi organ failure and five patients died. In univariate analysis, revisional surgery predisposed for, severe complications and mortality *(p-values 0.003 (OR 2.2) and 0.017 (OR 6.7)) Table 4*.

The two patients who died in the primary surgery group both suffered from anastomotic leakage followed by abdominal sepsis and multi organ failure. In the revisional surgery group, one patient also died from anastomotic leakage, another patient died due to cardiac tamponade after removal of the band and the last patient from pulmonary embolism during prolonged admission for anastomotic leakage despite daily prophylactic nadroparine 0.6 ml.

Anastomotic leakage (1.2 versus 1.9%) and perioperative bleeding (2.4 versus 3.2%) occurred more often in the revisional surgery group.

Table 3: Baselines primary versus revisional LRYGB all types

Baseline	Primary LRYGB (n = 1359)	Revisional surgery (n = 308)	P value
Gender F/M	1105/254	266/42	0.039
Age (years; SD)	44.5 (15.1)	45.3 (10.2)	0.348
Weight (kg; SD)	127.7 (22.8)	118.0 (21.3)	<0.001
BMI (kg/m^2; SD)	44.8 (6.3)	41.6 (6.4)	<0.001
Waist (cm; SD) (n = 1352)	129.7 (14.7)	124.1 (13.9)	<0.001
Comorbidities			
Diabetes (%)	402 (29.6)	60 (19.5)	<0.001
Dyslipidemia (%)	317 (23.3)	55 (18.0)	0.048
Hypertension (%)	569 (41.9)	100 (32.5)	0.002
OSA Y/N (%) (n = 1239)	668 (64.1)	111 (52.1)	0.001
AHI >30 (%)	268 (19.8)	39 (12.7)	0.004
Alcohol (%)	508 (38.2)	110 (38.7)	0.866
Smoking (%)			0.723
— *Now*	263 (19.6)	56 (19.2)	
— *Former*	315 (23.5)	63 (21.6)	
OS- MRS class			
OS- MRS A	717 (52.8)	187 (60.7)	0.011
OS- MRS B	538 (39.6)	104 (33.8)	0.058
OS- MRS C	104 (7.7)	17 (5.5)	0.193
Age > 45 years	683 (50.3)	170 (55.2)	0.118
BMI > 50 kg/m^2	272 (20.0)	35 (11.4)	<0.001
Risk on PE	300 (22.1)	49 (15.9)	0.016

AHI: apnea- hypopnea- index; BMI: body mass index; F: female; (L) AGB: (laparoscopic) adjustable gastric band; LRYGB: laparoscopic Roux-en-Y gastric bypass; M: male; N: no; OSA: obstructive sleep apnea; OS-MRS: Obesity Surgery Mortality Risk Score; PE: pulmonary embolism; SD: standard deviation; Y: yes

Table 4: Complications between primary and revisional surgery

Complications	Total group N = 1666	Primary surgery N = 1358	Revisional surgery N = 308	P- value	Odd's ratio (95% CI)
Complications < 30 days (%)	187 (11.2)	143 (10.5)	44 (14.3)	0.059	1.4 (1.0-2.0)
Clavien- Dindo ≥ 3 (< 30 days) (%)	72 (4.3)	49 (3.6)	23 (7.5)	**0.003**	2.2 (1.3-3.6)
Conversion during the procedure	6 (0.4)	4 (0.3)	2 (0.6)	0.348	2.2 (0.4-12.1)
Mortality	5 (0.3)	2 (0.1)	3 (1.0)	**0.017**	6.7 (1.1-40.1)
Clavien- Dindo 1	57 (3.4)	48 (3.5)	9 (2.9)	**0.025**	
Clavien- Dindo 2	56 (3.4)	45 (3.3)	11 (3.6)		
Clavien- Dindo 3a	17 (1.0)	9 (0.7)	8 (2.6)		
Clavien- Dindo 3b	45 (7.2)	34 (2.5)	11 (3.6)		
Clavien- Dindo 4a	3 (0.2)	2 (0.1)	1 (0.3)		
Clavien- Dindo 4b	1 (0.1)	1 (0.1)	0 (0.0)		
Clavien- Dindo 5	5 (0.3)	2 (0.1)	3 (1.0)		

*of one patient with hypokalemia the Clavien-Dindo classification was unknown.

Table 5a: Analysis revisional LRYGB

Baseline (n = 308) & (n = 288)	No complication < 30 days	Complication < 30 days (n = 44)	P value	No complication < 30 days	Clavien-Dindo ≥ 3 (n = 24)	P value
Gender F/M	230/34	36/8	0.343	230/34	21/3	0.958
Age (years; SD)	44.9 (10.3)	47.6 (9.7)	0.116	44.9 (10.3)	50.0 (8.6)	0.022
Weight (kg; SD)	118.0 (21.5)	118.0 (20.7)	0.994	118.0 (21.5)	115.9 (21.1)	0.642
BMI (kg/m^2; SD)	41.7 (6.5)	41.5 (6.1)	0.844	41.7 (6.5)	40.7 (6.6)	0.505
Waist (cm; SD) (n = 166)	123.2 (13.4)	130.0 (16.0)	0.038	123.2 (13.4)	128.6 (16.5)	0.232
Comorbidities						
Diabetes (%)	51 (19.4)	9 (20.5)	0.869	51 (19.4)	4 (16.7)	0.745
Dyslipidemia (%)	43 (16.3)	12 (27.9)	0.067	43 (16.3)	5 (21.7)	0.507
Hypertension (%)	79 (29.9)	21 (47.7)	0.020	79 (29.9)	12 (50.0)	0.043
OSA Y/N (%) (n = 220)	91 (51.4)	20 (55.6)	0.650	91 (51.4)	13 (65.0)	0.249
AHI >30 (%)	30 (11.4)	9 (20.5)	0.095	30 (11.4)	4 (16.7)	0.445
Alcohol (%)	94 (38.5)	16 (40.0)	0.859	94 (38.5)	8 (38.1)	0.969
Smoking (%)			0.406			0.953
— *Now*	45 (17.9)	11 (26.8)		45 (17.9)	4 (19.0)	
— *Former*	55 (21.9)	8 (19.5)		55 (21.9)	4 (19.0)	

AHI: apnea- hypopnea- index; BMI: body mass index; F: female; LRYGB: laparoscopic Roux-en-Y gastric bypass; M: male; N: no; OSA: obstructive sleep apnea; SD: standard deviation; Y: yes

Table 5b: Distribution among the OS-MRS in revisional LRYGB

Baseline (n = 308) & (n = 288)	No complication < 30 days	Complication < 30 days (n = 44)	P value	No complication < 30 days	Clavien-Dindo ≥ 3 (n = 24)	P value
OS- MRS class			0.073			0.193
OS- MRS A	167 (63.3)	20 (45.5)		167 (63.3)	11 (45.8)	
OS- MRS B	84 (31.8)	20 (45.5)		84 (31.8)	12 (50.0)	
OS- MRS C	13 (4.9)	5 (11.1)		13 (4.9)	1 (4.2)	
Age > 45 years	143 (54.2)	27 (61.4)	0.374	143 (54.2)	16 (66.7)	0.238
BMI > 50 kg/m^2	29 (11.0)	6 (13.6)	0.608	29 (11.0)	3 (12.5)	0.821
Hypertension (%)	79 (29.9)	21 (41.7)	0.020	79 (29.9)	12 (50.0)	0.043
Risk on PE	38 (14.4)	11 (25.0)	0.075	38 (14.4)	6 (25.0)	0.167

BMI: body mass index; F: female; LRYGB: laparoscopic Roux-en-Y gastric bypass; OS-MRS: Obesity Surgery Mortality Risk Score; PE: pulmonary embolism;

Revisional Laparoscopic Roux-en-Y gastric bypass and the impact of the OS-MRS

Revisional surgery from (L)AGB into LRYGB was performed in 308 patients of which 44 (14.2%) developed a complication within 30 days. Twenty-four out of these 44 complications (54.5%) were severe. In patients developing any short-term complication, waist circumference was significantly higher in the univariate analysis, as was hypertension with a p value of 0.038 and 0.020, respectively. This difference in incidence waist circumference between the groups disappeared in patients with a severe complication *(p = 0.232)*, as displayed in *Table 5a*.

In revisional surgery the OS-MRS did not predict the risk of complications with a p- value of 0.193 although the incidence of complications increased with OS-MRS A, B, C, respectively. In addition, of the individual components of the OS-MRS, only hypertension was significant in the univariate analysis, none of the others showed any predisposition *Table 5b*.

Discussion

The authors report that the OS- MRS does not accurately predict the risk of short term postoperative complications classified according to the Clavien-Dindo classification, even though it was used for this purpose in several studies. The only predictor for all short-term complications was revisional surgery. The OS-MRS has not been validated for revisional surgery; one study that analysed the OS-MRS for its applicability in the prediction of complications had a mixed patient cohort without separate analysis for primary and revisional surgery and another used both primary sleeve gastrectomy and primary gastric bypass but did not take revisional bariatric surgery into account [25,26].

The mortality and even morbidity of bariatric surgery has dramatically decreased in the last decades, especially after introduction of laparoscopy [3,27]. A recent study of Brolin et al recognizes this phenomenon and inventories the value of the OS-MRS in prediction of mortality in the laparoscopic surgery group compared to open surgery. They found significant differences in the predictive value of the OS-MRS in the open versus the laparoscopic group. Hypertension was not a predictor in both the open and laparoscopic group and BMI and age were the strongest predictors [28]. This said, morbidity and mortality rates in bariatric surgery remains highly relevant and attempts are continuously being made to decrease the risk on

these potential fatal events [3]. To estimate the risk of mortality, de Maria et al. developed the OS-MRS [7] and also validated this classification in other cohorts [8-10]. The classification proved to accurately predict the risk of perioperative mortality in primary bariatric surgery. Mortality was between 0.4 and 1.5% in the original and validation set respectively [7,9]. Only five patients were converted into open surgery, the differences in predictive value of the OS-MRS between open and laparoscopic surgery as previously mentioned, probably applies for this study as well [28]. In the present study, the mortality rate was 0.1% after primary surgery and 1.0% in the group that underwent revisional surgery. Both are consistent with literature [4,22].

Although the two previously mentioned studies investigating complications found a good accuracy in predicting complications by means of the OS-MRS with a p value of 0.002 and 0.004 respectively, this was not demonstrated in the present study including a total of 1667 patients with separate analysis for primary (n = 1359) and revisional (n = 308) surgery and for all short term and severe short-term complications [25,26]. The study of Sarela et al. (n=381) only used the nature of the complications to classify them, and reported 19 (5.0%) patients with a postoperative complication; This study contains not only a small study population and a small complication rate resulting in p values earlier to be significant, but also include a small percentage (1.6%) of surgical procedures being revisional [25]. The current study provides an over three-fold sample size in primary surgery and has separate analysis for revisional surgery and severe complications. In addition, Lorente et al. (n = 198) used the Clavien-Dindo to classify the complications comparable to the present study, next to the classification according to their nature reported a complication rate of 12.6%. However, all procedures were primary surgeries, whereas none were revisional procedures, which appeared to be the only significant predictor for postoperative complications in the current study [26]. Recently, another study was published, comparing different risk stratification models finding that the OS-MRS did not adequately predicts the risk on postoperative complications, which is comparable with the present results [29]. Their study group existed of 740 patients of which 172 (19.6%) developed a complication and only seven patients (0.9%) were categorized as OS- MRS class C. The present study has an almost twofold sample size and also investigates the predictive value of the OS-MRS in complications after revisional surgery. Additionally, 116 (7.1%) of the patients were categorized as OS-MRS class C, which was more in line with the original and validation studies *Table 3*.

The increased risk due to age, male gender and BMI were the only risk factors found by Efthimiou et al., as a consequence, they differed from the variables in the original and valida-

tion study. Therefore, the importance of each of the five individual variables in the OS-MRS varied between the different studies [7-9] for which the present study considered the individual variables of the OS-MRS for complications as well apart from the classes. For primary surgery, none of the parameters were statistically significant. It can be concluded that the OS-MRS is not sufficient to predict early postoperative complications after primary LRYGB.

Within revisional surgery, only a higher waist circumference (not a variable of the OS-MRS) for all complications and hypertension for all and severe were statistically significant. None of the other four parameters of the OS-MRS scoring system could be identified as of any importance. Looking at the incidence of postoperative complications among the different classes of the OS-MRS, an increase was observed between A, B and C respectively for both overall and severe complications. Although this increase does not reach statistical significance, the difference between primary and revisional surgery is striking. The lack of statistical significance can possibly be assigned to the relatively small cohort of 286 patients or other parameters, not identified within the baselines, are of more importance as risk factor concerning complications after revisional LRYGB.

Several arguments can be proposed to why the OS-MRS does not predict the risk on post-operative complications in the present cohort. Moreover, not one of its individual parameters had a significant relation with postoperative complications and primary surgery and only one within revisional. Although this is the largest cohort testing the OS-MRS for its accuracy regarding the prediction of complications, the OS-MRS was developed and validated in two far bigger patient groups to begin with. Secondly, the development took place more than a decade ago. However, from that time the experience with bariatric surgery and the annual number of procedures performed increased significantly. More procedures are performed laparoscopic as previously mentioned [28]. This increase in experience might decreases the value of patient characteristics such as BMI and comorbidities on the complication rate and increases the importance of other characteristics.

Another thought concerning why the OS-MRS does not predict complications is the “Failure to Rescue” idea. Although the risk of complications is the same between the patients of different OS-MRS classes (as shown in this study), the possibility of rescuing the patient is different, resulting in a higher mortality rate in patients with a higher OS-MRS class. Therefore, the OS-MRS can predict mortality, but not morbidity after bariatric surgery.

Most revisional procedures were carried out as one step procedure except for a few (nine) cases due to band erosion, band slippage or future pouch fragility. Although considered safe enough to be performed, revisional surgery has a 5% higher complication rate than primary surgery (10.5% versus 14.7%), which is almost a 50% increase in complications. Still, it is globally carried out in a significant number of patients, marking its importance as an option to increase weight loss for morbidly obese patients [21,30]. Revisional surgery can be regarded as more complex than primary due to the scar tissue complicating pouch creation and the possibility of the adhesions in a previously operated area [31]. Although the higher complication rate in the revisional surgery group is consisted with literature, most published studies concern relatively small patient groups, combine patients from different centres or compare the laparotomic with the laparoscopic approach or the one- with two step revisions [4,12,22]. With the disappointing long-term results of the (L)AGB and the high long-term complication rate, the demand for revisional procedures is increasing. This is shown in an increase of reoperations on (L)AGB, which has nearly doubled between 2005 and 2008 [32]. Although some insurance companies and institutions are against revisional surgery, arguments used in benefit of the procedure are considered more convincing stating that morbid obesity is a chronic illness and that reoperation is a moral obligation when initial treatment fails or relapse occurs [12,30], especially as multiple studies showed revisional bariatric surgery can be regarded as successful [32,33]. This stated, providing structural insight in the complications by means of a structured registration of complications and with the results improving, the procedure can be considered as moral obligation of performing revisional surgery.

Conclusion

This study concludes that the OS-MRS does not correlate with the development of postoperative complications. Since these complications occur in around 10% of the bariatric surgery patients, a system predicting not only mortality, but also postoperative complications seem desirable. Additionally, structured complication registration, training of medical staff and inter-centre cooperation is necessary to further improve the (revisional) LRYGB procedures and other types of bariatric surgery. Future studies should focus on predicting the possibility and severity of perioperative complications rather than mortality alone. Such a scoring system would facilitate surgeons and patients to make an informed decision prior to primary or revisional LRYGB in this elective type of surgery.

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